Appendix A: Airport Pavement Management System Review

The Utah Division of Aeronautics (UDOA) has undertaken pavement management activities for many years. Through these efforts, UDOA has compiled valuable information related to its airport pavement infrastructure. As part of the Utah Continuous Airport System Plan (UCASP), the consultant team reviewed UDOA's existing procedures and policies regarding airport pavement evaluation and pavement management. The results of this review were used to formulate recommendations included in this Chapter for continued development of UDOA's pavement management program.

This review of UDOA's airport pavement management system is organized as follows:

- Data Collection Methods
- Overview of UDOA's Airport Pavement Management System (APMS)
- Airport Inventory
- Airport Pavement Evaluation
- Micro PAVER Database Set-Up
- Pavement Analysis, Reporting, and Outreach
- Pavement Performance Goals
- Comparison of UDOA's APMS Practices With Other State Aviation Agencies
- Recommendations for Changes and Additions to UDOA's APMS Activities

DATA COLLECTION METHODS

On December 4, 2006, Applied Pavement Technology, Inc. (APTech) and Wilbur Smith Associates (WSA) conducted an interview with UDOA staff. The purpose of this interview was to obtain background information on UDOA's current pavement management practices.

The interview results were supplemented by data gathered by WSA during the inventory process of the UCASP. Publications were consulted that describe the current state of the practice for airport pavement management at the state level throughout the United States. In addition, UDOA provided a copy of their current Micro PAVER pavement management system database, which was used to document the version of the software being used by UDOA and to determine UDOA's customization of the software (unit costs, performance models, and maintenance policies).

OVERVIEW OF UDOA's APMS

UDOA's original APMS activities date back to 1987. At that time, UDOA evaluated three airports and used the information collected to establish its initial pavement management database. By 2000, UDOA had expanded the database to include its current level of 43 airports. These airports included all of the airports that are in the

UCASP 2007 Study except Salt Lake City International, Salt Lake City Municipal #2, Tooele Valley, and the Jake Garn Airport.

Initially, UDOA used the dTIMS pavement management software developed by Deighton Associates Limited. This is proprietary software that was developed for road pavement management applications. It has been used by the Utah Department of Transportation for the management of its road network for over 20 years. UDOA is the only known state aviation agency that has used dTIMS for airport pavement management.

In 2001, UDOA converted its APMS to the Micro PAVER pavement management system. Micro PAVER is software developed and maintained by the United States Construction Engineering Research Laboratory (USA-CERL). Micro PAVER is supported primarily through funding from the Federal Aviation Administration (FAA) and various branches of the United States military. The conversion of the dTIMS database to Micro PAVER provided several benefits to the UDOA, including a significant reduction in the cost for the pavement management software, the elimination of dependency on a single consultant for software support, and a large user's group of state aviation agencies using the software for the same purpose as UDOA.

UDOA has undertaken all of its pavement management activities – from data collection to data analysis to report generation – using internal staff. One person on staff is responsible for all aspects of the APMS, and this person works with the software almost continuously and conducts all of the pavement evaluations. Outside consultants have not been retained to assist. Funding for the APMS activities comes from UDOA's state budget and FAA funding.

The information contained in the APMS and the analysis outputs are primarily used by the FAA, UDOA, and the Utah Transportation Commission. In addition, individual airports and consultants occasionally use outputs from the APMS.

The information in the APMS is used in a variety of ways, including:

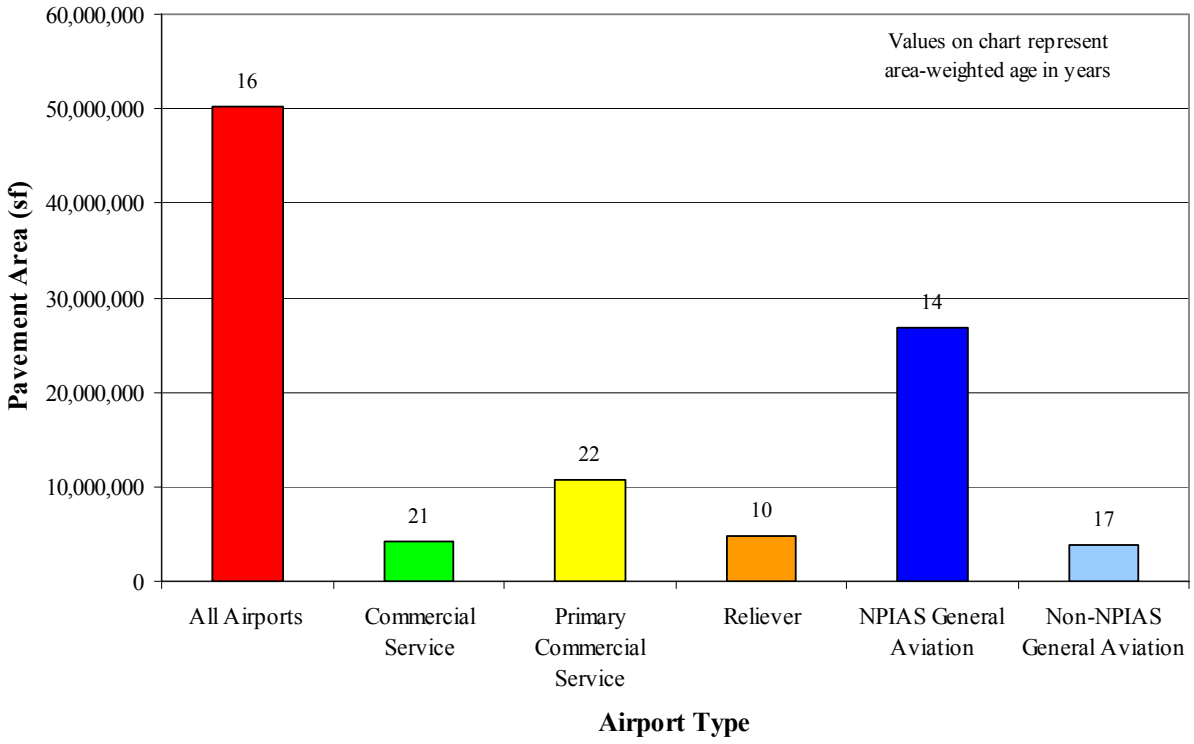
- Tracking current condition
- Predicting future condition under different funding scenarios
- Identifying pavement-related needs
- Making pavement-related funding decisions
- Prioritizing the funding of pavement-related projects
- Feeding information into the state geographic information system (GIS)

UDOA performs some of the analysis of the pavement data using Micro PAVER and some external to that software.

AIRPORT INVENTORY

Exhibit A-1, below, shows the extent of pavement area in the UDOA Micro PAVER database compared to the airport type, and **Table A-1** lists the 43 airports that are currently in the database. Three are classified as primary commercial service airports, three are commercial service airports, one is a reliever airport, and the remaining 36 are general aviation airports. All airside pavements except taxilanes are included in the database. These pavements comprise approximately 50 million square feet of pavement. **Exhibits A-1** and **A-2** show the distribution of pavement area by pavement use (runway, taxiway, and apron) and by airport classification, respectively.

Exhibit A-1
Pavement Area Versus Airport Classification



Source: Applied Pavement Technology Inc, UDOA, 2006

Table A-1
Airports in UDOA's APMS

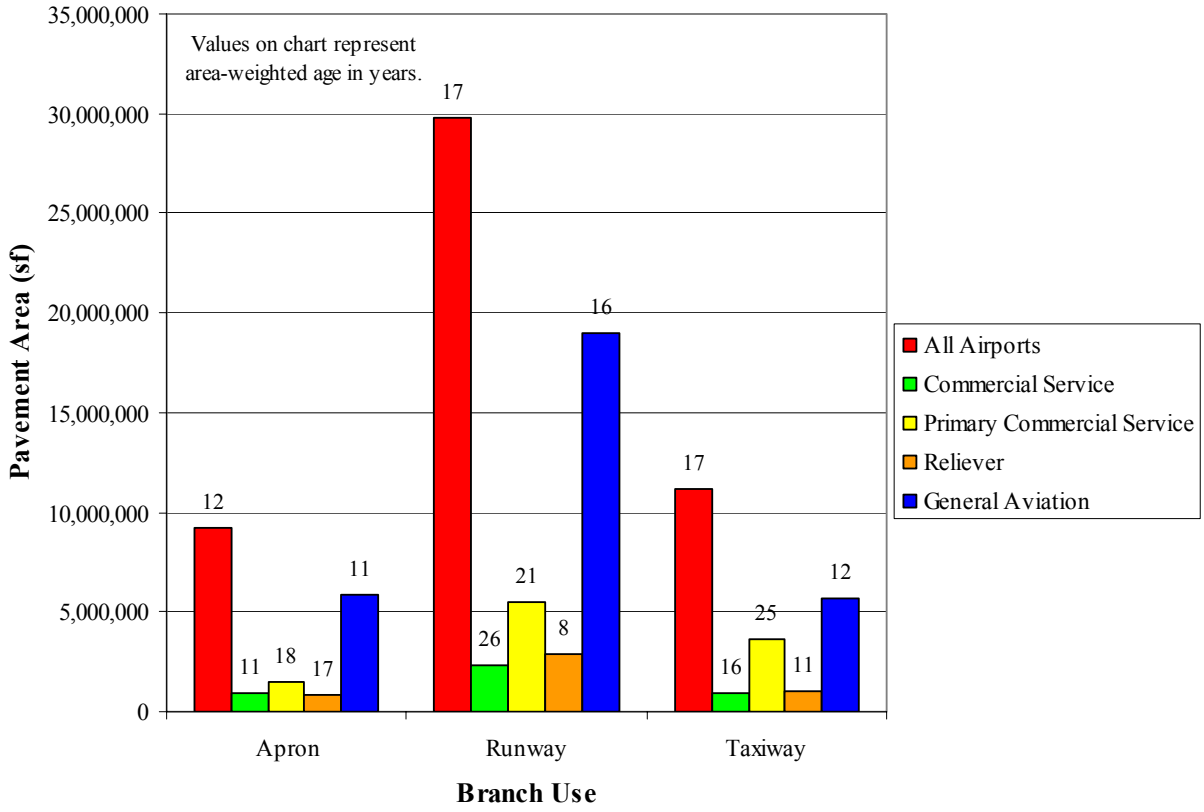
Airport Name	Associated City	Classification	NPIAS	First PCI Inspection[1]	Most Recent PCI Inspection[1]
Beaver Municipal	Beaver	General Aviation	NPIAS	1989	2006
Blanding Municipal	Blanding	General Aviation	NPIAS	1991	2006
Bluff	Bluff	General Aviation	Non-NPIAS	2000	2005
Brigham City	Brigham City	General Aviation	NPIAS	1988	2006
Bryce Canyon	Bryce Canyon	Commercial Service	NPIAS	1987	2005
Bullfrog Basin	Glen Canyon National Recreation Area	General Aviation	Non-NPIAS	1990	2006
Cal Black Memorial	Halls Crossing	General Aviation	NPIAS	1994	2006
Canyonlands Field	Moab	Commercial Service	NPIAS	1989	2006
Carbon County	Price	General Aviation	NPIAS	1988	2005
Cedar City Regional	Cedar City	Primary Commercial Service	NPIAS	1989	2006
Delta Municipal	Delta	General Aviation	NPIAS	1989	2006
Duchesne Municipal	Duchesne	General Aviation	NPIAS	1989	2005
Dutch John	Dutch John	General Aviation	Non-NPIAS	1997	2005
Escalante Municipal	Escalante	General Aviation	NPIAS	1989	2005
Fillmore Municipal	Fillmore	General Aviation	Non-NPIAS	1991	2005
Green River Municipal	Green River	General Aviation	NPIAS	1988	2005
Hanksville	Hanksville	General Aviation	NPIAS	1989	2005
Heber City Municipal	Heber	General Aviation	NPIAS	1991	2005
Huntington Municipal	Huntington	General Aviation	Non-NPIAS	1990	2005
Hurricane	Hurricane	General Aviation	Non-NPIAS	1990	2005
Junction	Junction	General Aviation	Non-NPIAS	1994	2006
Kanab Municipal	Kanab	General Aviation	NPIAS	1988	2004
Logan-Cache	Logan	General Aviation	NPIAS	1990	2006

Table A-1
Airports in UDOA's APMS

Airport Name	Associated City	Classification	NPIAS	First PCI Inspection[1]	Most Recent PCI Inspection[1]
Manila	Manila	General Aviation	Non-NPIAS	1989	2005
Manti-Ephraim	Manti	General Aviation	NPIAS	1990	2005
Milford Municipal	Milford	General Aviation	NPIAS	1990	2005
Monticello	Monticello	General Aviation	NPIAS	1990	2006
Morgan County	Morgan	General Aviation	Non-NPIAS	1989	2006
Mount Pleasant	Mount Pleasant	General Aviation	Non-NPIAS	1989	2005
Nephi Municipal	Nephi	General Aviation	NPIAS	1987	1998
Ogden-Hinckley Municipal	Ogden	Reliever	NPIAS	1990	2004
Panguitch Municipal	Panguitch	General Aviation	NPIAS	1990	2005
Parowan	Parowan	General Aviation	NPIAS	1990	2006
Provo Municipal	Provo	General Aviation	NPIAS	1988	2006
Richfield Municipal	Richfield	General Aviation	NPIAS	1990	2005
Roosevelt Municipal	Roosevelt	General Aviation	NPIAS	1987	2005
Salina-Gunnison	Salina	General Aviation	Non-NPIAS	1991	2005
Skypark	Bountiful	General Aviation	Non-NPIAS	1988	2005
Spanish Fork-Springville	Spanish Fork	General Aviation	NPIAS	1990	2005
St. George Municipal	St. George	Primary Commercial Service	NPIAS	1988	2006
Vernal	Vernal	Commercial Service	NPIAS	1999	2006
Wayne Wonderland	Loa	General Aviation	NPIAS	1990	2006
Wendover	Wendover	Primary Commercial Service	NPIAS	2000	2005

[1]Based on the runway inspection dates.
[2]Nephi Muni: The pavement sections at this airport have construction data entered in years 2004 and 2005 and no inspections appear to have been performed since 1998. This was due to the impending reconstruction of the airport.
Source: Applied Pavement Technology Inc, UDOA, 2006

Exhibit A-2
Pavement Area Versus Use



Source: Applied Pavement Technology Inc, UDOA, 2006

UDOA estimates that approximately 70 percent of pavement work history for the 43 airports in the UDOA APMS has been retained. Since this work history dates back to the original construction of the pavements, this is a very good percentage. It appears that most, if not all, the pavement-related work conducted since 2001 has been captured in the database.

AIRPORT PAVEMENT EVALUATION

UDOA evaluates the condition of the airport pavements using the Pavement Condition Index (PCI) methodology. The PCI procedure is the standard used by the aviation industry to visually assess pavement condition. It was developed to provide a consistent, objective, and repeatable tool to represent the overall pavement condition. This methodology involves walking over the pavement, identifying the type and severity of distress present, and measuring the quantity of distress.

The PCI scale ranges from a value of 0 (representing a pavement in a failed condition) to a value of 100 (representing a pavement in excellent condition). In general terms, pavements above a PCI of 70 that are not exhibiting significant load-related distress will

benefit from preventive maintenance actions, such as crack sealing and surface treatments. Pavements with a PCI of 40 to 70 may require major rehabilitation, such as an overlay. Often, when the PCI is less than 40, reconstruction is the only viable alternative due to the substantial damage to the pavement structure. It should be noted that a PCI value is based on visual signs of pavement deterioration and does not provide a measure of structural integrity or capacity.

The PCI procedure is documented in the following publications:

- The U.S. FAA Advisory Circular (AC) 150/5380-6A, *Guidelines and Procedures for Maintenance of Airport Pavements* (2005).
- The American Society for Testing and Material (ASTM) Standard D5340-04e1, *Standard Test Method for Airport Pavement Condition Index Surveys*.

Through discussions, it was determined that UDOA has been performing pavement inspections in accordance with FAA AC 150/5380-6, which is an obsolete version of 150/5380-6A. FAA AC 150/5380-6 was published in 1982 and was replaced in 2003 by 150/5380-6A. Rather than providing instructions on the PCI procedure, this revised circular refers the user directly to ASTM Standard D5340. UDOA now has a copy of 150/5380-6A. However, UDOA does not have a copy of the ASTM Standard D5340, which is needed to effectively use 150/5380-6A.

A single staff member of UDOA conducts the PCI inspections. He was trained by his predecessor in the procedure according to FAA AC 150/5380-6 approximately five years ago and has not had any subsequent training.

Like all other states with APMS, UDOA does not inspect 100 percent of the pavement area. Rather, UDOA inspects a portion of the pavement area to be evaluated. Once the number of sample units that need to be inspected has been determined a random number generator is used to select which sample units to inspect. This is a variation from AC150/5380-6A which recommends stratified, or systematic, random sampling.

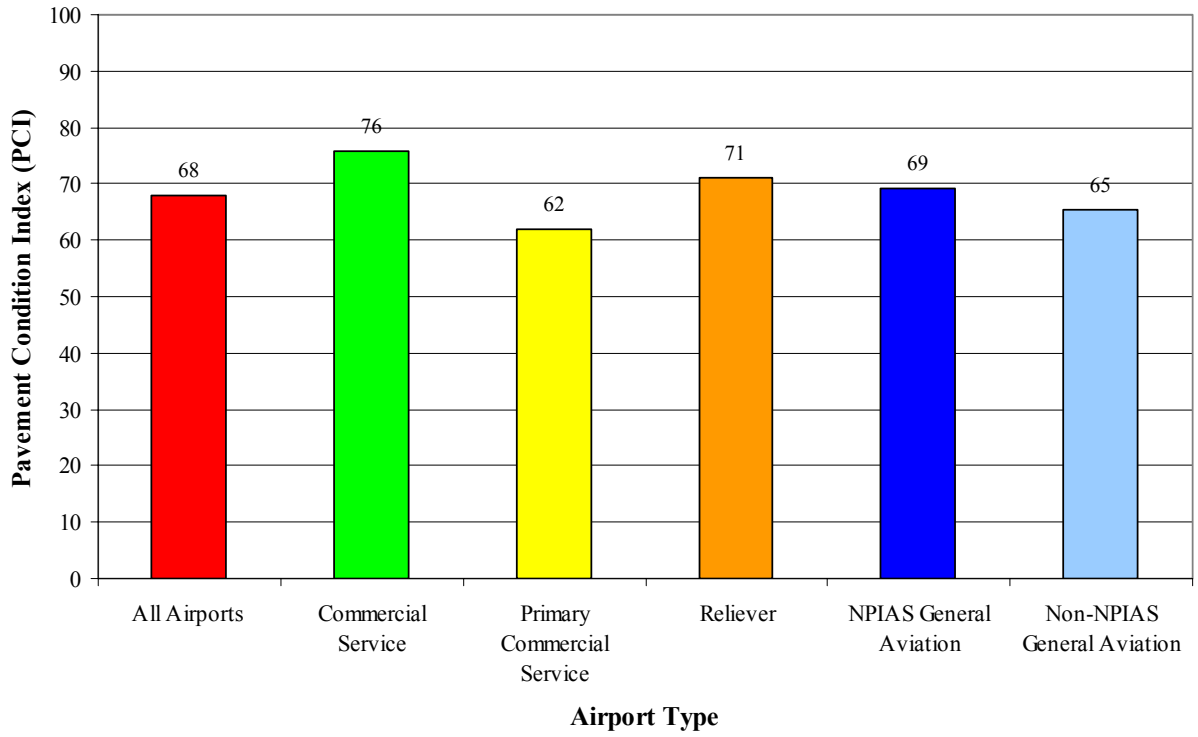
UDOA does not employ formal quality control procedures during its PCI inspections other than re-inspecting a constant control sample unit during each inspection. Since the same individual conducts all the inspections and has 5 years of experience, this increases the consistency in inspections over time. However, the lack of training on current inspection standards does not ensure that the distresses are being identified and severity levels determined in accordance with ASTM D5340-04e1.

The initial goal of UDOA was to inspect each airport on a two year cycle; but staffing constraints have resulted in an actual inspection cycle closer to 2 ½ years.

No other types of pavement evaluation – such as structural evaluation or coring/materials testing – are performed as part of UDOA's APMS process. However, UDOA does evaluate the condition of the paint markings on the pavement and enters

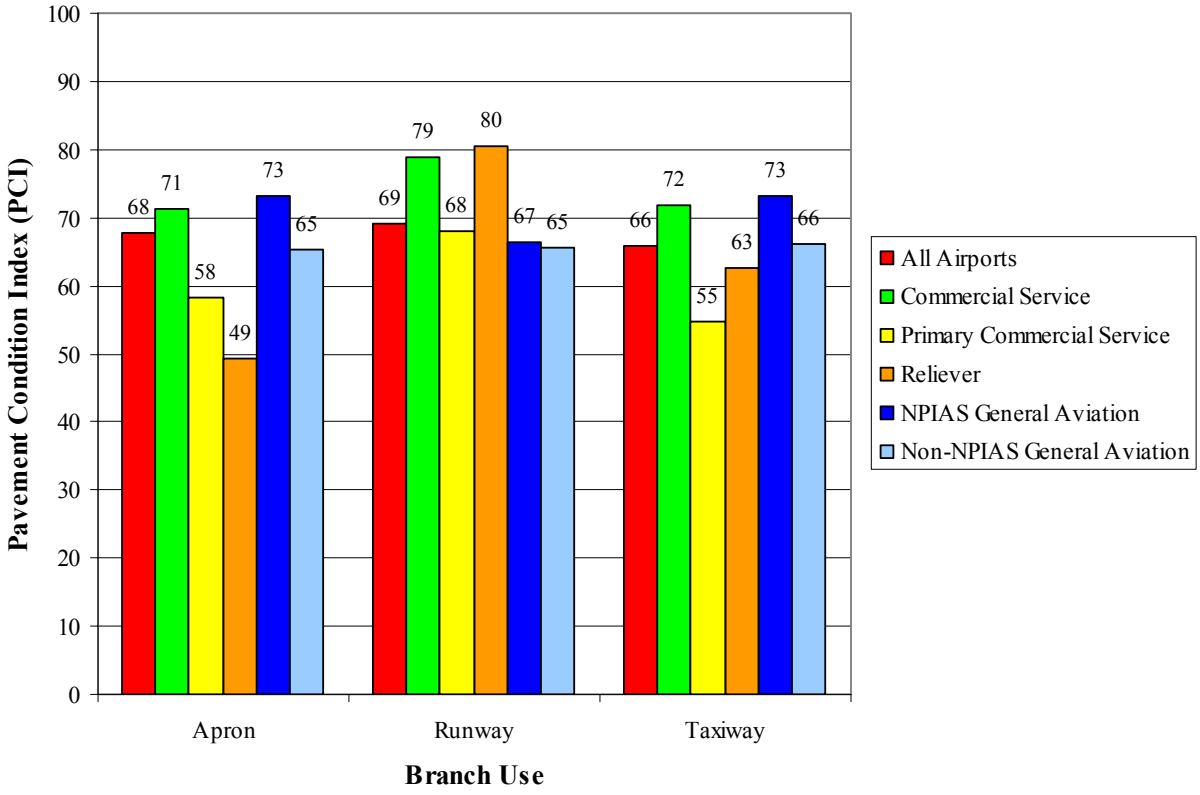
that into the database. UDOA also observes drainage conditions during the PCI inspections, although no formal measurements of drainage factors are collected.
Using the Micro PAVER database provided by UDOA, the overall pavement conditions at the time of last inspection were calculated. Overall, the pavement system has an area-weighted PCI value of 68. **Exhibits 3** and **4** summarize the area-weighted condition of the UDOA pavement system by airport classification and pavement use. Please recall that the following airports are not included in these statistics: Salt Lake City International, Salt Lake City Municipal #2, Tooele Valley, and Jake Garn Airports.

Exhibit A-3
Area-weighted Pavement Condition Versus Airport Classification



Source: Applied Pavement Technology Inc, UDOA, 2006

Exhibit A-4
Area-weighted Pavement Condition Versus Use



Source: Applied Pavement Technology Inc, UDOA, 2006

Micro PAVER DATABASE AND SOFTWARE SET-UP

At the time of the interview, UDOA was using version 5.1 of Micro PAVER, obtained from the FAA. This is an old version of the software that was replaced several years ago; it did not calculate PCI values in accordance with the latest version of FAA AC 150/5380-6A or ASTM D5340. In December 2006, UDOA obtained version 5.3 of Micro PAVER.

The UDOA staff member responsible for updating the database and analyzing data was self-trained on the use of Micro PAVER. The quality control process employed by UDOA consists of the data being entered, printed, and then hand-checked against the original data sheets. The same person that enters the data performs the quality control.

There are several features of Micro PAVER that should be customized to make it a more useful tool for decision-making by UDOA. The major customization features are as follows:

- A Micro PAVER database has many user-defined fields at the network (individual airport) level, branch (runway, taxiway, or apron) level, and section (portions of a branch with common characteristics such as age, surface type, and condition) level. UDOA has made use of a few of these to store information, such as whether an airport is in the NPIAS and the condition of the paint during the last inspection.

- Micro PAVER is much more useful and provides more realistic analysis outputs when it is customized to include an agency's actual maintenance policies and localized costs. This can include a standard repair action for common distresses and unit costs for specific materials used for pavement maintenance and rehabilitation. During updates of the software UDOA has lost customization information; therefore, it currently modifies the default tables that come with Micro PAVER rather than storing the information in separate tables.

- Pavement performance models – used to predict future conditions – should be developed using historic pavement condition data. At the state level, these models are typically defined by: (1) pavement surface type - original asphalt cement concrete (AC), Portland cement concrete (PCC), asphalt overlay on AC (ACC), or asphalt overlay on PCC (APC); (2) pavement use - runway, taxiway, and apron, and (3) airport classification/traffic level, and geographic location or elevation. UDOA has three performance models – one for runways, one for taxiways, and one for aprons.

A very important part of the customization of the Micro PAVER software is the establishment of a critical PCI value. This value is set for each pavement performance model using the performance modeling tool. In general, when performing an analysis with the Micro PAVER software, pavements predicted to have a PCI value below the critical PCI value set by the user are triggered for major rehabilitation; those above the critical PCI value are triggered for preventive maintenance (localized and global). In discussions with UDOA during the interview, it was stated that the desired critical PCI levels are a PCI of 50 for aprons, 55 for taxiways, and 60 for runways. These values must be established both in the Minimum Conditions Table of Micro PAVER as well as specifically identified in the performance models themselves.

PAVEMENT ANALYSIS, REPORTING, AND OUTREACH

UDOA runs an initial analysis of pavement needs with Micro PAVER and feeds that information into an Excel spreadsheet which is used to prioritize pavement projects. This information is then sent to the UDOA Airport Planner for use in developing pavement maintenance and rehabilitation programs. UDOA does investigate different funding levels and reports on those to agencies such as the Transportation Commission; however, different budget tables were not contained in UDOA's Micro PAVER set-up at the time of the interview. It is assumed that the different budget scenarios are investigated outside of the Micro PAVER software.

Currently, UDOA's external reporting of APMS is very limited. Reports are not routinely provided to the airports that are evaluated. The inspection data is provided to individual airports or airport consultants upon request. APMS information is not currently available via UDOA's website; however, UDOA plans to incorporate this feature in the future.

In 2003 UDOA conducted a presentation on pavement management and pavement preservation at the Utah Airport Owners and Operators (UAOA) Association meeting. UDOA has not recently conducted outreach pertaining to its pavement management activities.

PAVEMENT PERFORMANCE STANDARDS

Pavement performance standards are goals set by an agency regarding desired pavement condition. They are often established at different levels for different groups of pavements – for example, a higher condition level is usually set for primary runways than is for aprons. At this time UDOA has set its pavement performance standards the same as its critical PCI values – 60 for runways, 55 for taxiways, and 50 for aprons.

COMPARISON OF UDOA'S APMS PRACTICES WITH OTHER STATE AVIATION AGENCIES

As part of this project, UDOA's APMS practices were benchmarked with other state aviation agencies' practices. The benchmarking was based on a paper published at the 6th International Conference of Managing Pavements.[1] The information in this paper was updated with current information where available.

Number of Agencies with APMS and Software Used

Most state aviation agencies (88 percent) have APMS programs in place. Of these, 80 percent use the Micro PAVER software. Other software options used include proprietary software products (DSS and AIRPAV) and a software system developed by a university. One very small state does not use software. Utah and all the other states in the FAA Northwest Mountain Region all use the Micro PAVER software.

Method to Conduct APMS and Funding of APMS Activities

Method of Implementation

The majority (89 percent) of agencies with an APMS conduct their APMS activities using consultants or using a combination of internal staff and consultants. Only four states (Utah, Alaska, Minnesota, and North Carolina) conduct APMS activities using only internal staff. Nebraska also conducts almost all its APMS activities in house;

[1] [1]Covalt, M., C. Comer, and A. Muntasir, State Airport Pavement Management Practices and the Impact on Pavement Condition, 6th International Conference on Managing Pavements Proceedings, Australia, 2004.

however, it does receive assistance from consultants on software use and training. One state out of the 44 with active APMS uses a university to conduct its APMS activities.

The majority of states with APMS (approximately 82 percent) use FAA funding for at least a portion of their APMS work. Most states in the FAA Northwest Mountain Region use federal funding for their APMS activities. Further information on this funding follows:

- Colorado actively participates in the APMS process by assisting in the PCI inspections and by gathering the work history information. Colorado receives 90 percent funding for its APMS work at NPIAS airports from the FAA and funds the additional 10 percent for the NPIAS airports plus 100 percent for non NPIAS airports using Aviation funds (information provided by T.K Gwin of Colorado Division of Aeronautics). Denver International is excluded from the State's APMS activities.
- Washington receives between 90 percent and 95 percent funding for its APMS activities from the FAA for AIP eligible pavements at NPIAS airports and funds the remaining work at NPIAS airports and 100 percent at non NPIAS airports using state funds (information provided by Eric Johnson, Washington State Aeronautics). Seattle-Tacoma International, Spokane International, Tri-Cities Airport, and Bellingham International Airport are excluded from the State's APMS activities.
- Oregon and Idaho both fund APMS work for its general aviation airports through the AIP funded State System Plans; APMS work at the primary airports in these states is funded through AIP pavement grants paid directly to the individual airports (information provided by Bill Watson, FAA).
- Wyoming generates its own multi-year maintenance and rehabilitation plans. Wyoming receives federal funding for 50 percent of its APMS activities at NPIAS airports and funds the remaining activities at the NPIAS activities and all of the activities at the non NPIAS airports using state funds (information provided by Cheryl Bean, Wyoming Division of Aeronautics).
- PCI studies in Montana are funded with State System Plan funds on a 3-year cycle (information provided by Dave Spelling, FAA).
- UDOA's APMS for NPIAS airports is funded at the 95 percent level through FAA State System Plan funds (information provided by Kirk Nielsen, UDOA).

Although federal funding is available for state APMS activities, some states have not take advantage of this funding for the following reasons:

- Federal funds were not available when a state requested funding for APMS.
- The APMS had a low priority rating overall when compared to other projects being considered for federal funding so funding for it would have been delayed beyond the point deemed acceptable by the state.
- State staffing and resources were available to permit assignment of state staff to APMS work for the majority of their time.

- The state did not have the necessary match to receive federal funds.
- The state had sufficient resources, so federal funds were not needed. In some cases, states initiated their APMS programs using State funds but have transitioned over time to using federal funds.

Pavement Inspection Cycle

Public Law 103-305 states that if a NPIAS airport is conducting a PCI evaluation as part of pavement management activities a 3-year inspection cycle is sufficient. The majority of states have adhered to this 3-year cycle; however, a few of the states have lengthened or shortened this cycle. For those on the 3-year cycle, some states choose to inspect approximately one third of the airports each year and others inspect all the airports in one year and then essentially let the APMS go "dormant" for two years before starting the cycle again.

UDOA inspects its airports every two to three years. Wyoming, Colorado, Montana, Oregon, and Idaho inspect approximately one-third of their airports each year. Washington inspects all their airports in a given year; however, they had a 5 year gap between their initial implementation in 2001 and their 2006 update to their APMS. In the future they hope to return to the 3-year cycle.

Users of APMS Information

Who uses APMS information? Almost all of the states with APMS identify the most prevalent user of pavement management data besides their own agency is the FAA. The large majority of states report that individual airports and engineering consultants are primary users of their pavement management data. A few states relate that airlines and Regional Planning Organizations are additional users of the APMS information.

UDOA reports that the information contained in the UDOA APMS and the analysis outputs are primarily used by the FAA, UDOA, and the Utah Transportation Commission. In addition, individual airports and consultants occasionally use outputs from the APMS. All the states in the FAA Northwest Mountain Region also report that their own agency and the FAA are the two heaviest users of the APMS information. The individual airports are also common users of the information in Colorado, Washington, and Oregon.

Uses of the APMS Information

The APMS information is used by states in a variety of ways. All states with an APMS use it to monitor the overall condition of the state's pavement network. They use the data not only to monitor conditions of the airport infrastructure for internal purposes but also to report their findings to the individual airports and to the FAA. The FAA then may use that information to prioritize federally-funded work as well as in programming FAA state apportionment funds. In several cases, state aviation agencies are rated on the overall condition of the airport system and have performance objectives relative to the

overall PCI of their pavement system. The APMS provides the data needed to perform this evaluation.

For the majority of states, the APMS plays an important role in planning for the preservation of the pavement infrastructure through the timely maintenance and rehabilitation of that system. The majority of the states use the APMS data to provide guidance to the individual airports on the type of maintenance and rehabilitation they should conduct. A significant number of the states that have APMS (over 35 percent) have state-run pavement maintenance programs. These states all use their APMS data to provide input into their pavement maintenance programs. In the FAA Northwest Mountain Region, Wyoming, Montana, and Oregon use their APMS data to help run their state-run maintenance programs and Colorado has done so in the past.

A trend in recent years has been to use APMS data to document pavement-related needs and to lobby for funding for pavement preservation. Currently, over half of the states use their APMS to support these efforts. In the FAA Northwest Mountain Region, Washington uses APMS information to directly lobby the Legislature for increased funding levels, and Utah has done so in the past. No other states in the region are known to have made similar lobbying efforts.

The APMS is also used by individual airports to meet a substantial portion of the requirements of Public Law 103-305. Simply stated, Public Law 103-305 requires a NPIAS airport to have an "effective pavement maintenance management system" in place if they are to be eligible to receive federal funding for pavement reconstruction or rehabilitation. Basically, if the state has an up-to-date APMS then the only additional items that the individual airports have to complete to remain in compliance with the law are conducting monthly drive-by inspections and tracking maintenance that is needed and conducted at the airports.

Distribution of APMS Information

Over 80 percent of states with APMS print and distribute hard copy reports to the individual airports within the state. Interactive pavement management CDs and web-access are used to a much lesser extent. Many states also conduct presentations on airport pavement management topics at state aviation conferences.

UDOA does not distribute APMS information to individual airports or consultants unless they receive a specific request. The other states in the FAA Northwest Mountain region do distribute individual airport APMS reports. Washington State went one step further and conducted a series of outreach meetings throughout the state to educate the airports on airport pavement management and the cost savings of effective preventive maintenance.

Pavement Performance Goals

A few states in the FAA Northwest Mountain region have set overall goals for the condition of airport pavements. In Washington, the goal is an area-weighted PCI of 78 for all pavements (Washington State Department of Transportation Gray Notebook 2006). In Colorado, the goal is that every primary runway has an area-weighted PCI of 75 or higher (2005 Systems Plan). In Oregon, the goal is that 90 percent of the runways are in good or better condition (it is unknown what defines good and better; information obtained from Oregon Division of Aeronautics website).

RECOMMENDATIONS FOR CHANGES AND ADDITIONS TO UDOA's APMS ACTIVITIES

Based on a review of UDOA's current pavement management practices and comparing practices to other states, particularly those in the FAA Northwest Mountain Region, the following recommendations are made for UDOA's consideration.

Micro PAVER Set-Up

Version of Micro PAVER

At the time of the interview UDOA was using an outdated version of Micro PAVER and it was recommended that they obtain the current version of the software. In December 2006 UDOA upgraded its software to version 5.3 and converted its database to work with that version. It is recommended that UDOA maintain an annual subscription to the software which will allow it to obtain new versions as they are released.

Unit costs

At the time of the interview a review of UDOA's Micro PAVER setup showed that Utah-specific costs have been entered for global maintenance activities (thin overlays, surface treatments, etc.) but it appeared that Utah-specific costs have not been entered for localized maintenance activities (crack sealing, patching, etc.) or major rehabilitation by PCI range. Since the interview UDOA has entered these Utah-specific costs which will enable the program to generate more realistic maintenance and rehabilitation costs. It is recommended that UDOA review and update these costs on an annual or semi-annual basis.

Critical PCI values

Critical PCI values are established to determine whether maintenance or major rehabilitation should be triggered by Micro PAVER. During the interview UDOA expressed a desire to use Washington State's critical PCI values, which are presented in **Table A-2**.

Table A-2
Washington State Critical PCI Values

		Critical PCI Values		
Surface Type	**Load Classification**	**Runway**	**Taxiway**	**Apron**
Asphalt Cement Concrete Surface	< 60,000#	65	60	60
	≥ 60,000#	70	65	60
Portland Cement Concrete	< 60,000#	55	50	50
	≥ 60,000#	60	55	50

Source: Applied Pavement Technology Inc, UDOA, 2006

Currently, UDOA does not have the data in the Micro PAVER system to allow it to incorporate classification; however, the agency is working on including that information. In addition, while the Washington State values are an excellent goal budgetary constraints may require that UDOA reduce these values.

Maintenance policies

UDOA is currently using the default airfield maintenance policies that come with Micro PAVER. These maintenance policies are adequate; however, the following two changes are recommended for the maintenance of PCC pavements:

- Localized preventive maintenance for PCC pavements: change repair type of high severity blow-up from patching to slab replacement.
- Localized preventive maintenance for PCC pavements: change high-severity linear cracking from crack sealing to slab replacement.

Performance models

UDOA has pavement condition data dating back to the 1980's for the use in generating performance models. At this time UDOA uses three models (one for runways, one for taxiways, and one for aprons) in Micro PAVER. These models could be further refined to take into account airport classification, pavement type (original asphalt, asphalt overlaid with asphalt, portland cement concrete, or portland cement concrete overlaid with asphalt), and geographic location at a minimum. UDOA feels that with its limited work history data it should concentrate on refining the models based on geography and classification. As the database is further refined it is highly recommended that UDOA also look at developing separate models for pavements that are original construction and those that have received one or more overlays. The performance of these pavements is often significantly different.

It is very likely the resulting models would not have as much scatter in the data set as the existing models and would be more reliable and statistically valid for making future pavement condition predictions.

Pavement Evaluation Practices

The current practice of a one-person crew conducting the PCI inspections is not desirable from a safety or from a quality control perspective. It is recommended that UDOA adopt a two-person crew. This might include one UDOA and one consultant. Colorado uses the latter approach very successfully, as has Iowa in the past.

Reporting to Airports

Currently UDOA does not prepare or distribute individual airport pavement reports, partially due to Micro PAVER's limited reporting capabilities. It is recommended that this activity be added to UDOA's APMS process. This would maximize the usefulness and benefit of the APMS work for the individual airports. The posting of pavement information to UDOA's website would also be beneficial, and UDOA reports that it is currently pursuing this.

Training – PCI and Micro PAVER

The UDOA staff member responsible for all the APMS activities – ranging from data collection to data entry to data analysis – was self-trained on the PCI procedure and Micro PAVER. It is recommended that UDOA receive training as soon as possible on the PCI procedure and on version 6 of Micro PAVER when it is released.

Update of the APMS

We do not recommend that the UDOA turn over all its activities to a consultant. UDOA has expressed a desire to be actively involved in these activities. However, the UDOA could benefit greatly from outside assistance with some activities – including PCI inspections, customization of Micro PAVER, generation of individual airport reports, and training on the PCI procedure and the Micro PAVER software. These are all activities that the FAA funds for other states in the Northwest Mountain Region.

Pavement Performance Goal

It is recommended that UDOA consider the following pavement performance goals:

- Overall area-weighted PCI of the pavement system has a PCI of 65 or greater.
- Each primary runway has area-weighted PCI of 70 or greater.
- Each secondary runway has an area-weighted PCI of 60 or greater.

UDOA's Micro PAVER CUSTOMIZATION

Table A-3

UDOA's current localized preventive maintenance policy for airfields, asphalt-surfaced pavements (Micro PAVER airfield default table)

Distress Type	Severity Level	Maintenance Action
Alligator Cracking	Medium	Patching - AC Deep
	High	Patching - AC Deep
Block Cracking	Medium	Crack Sealing - AC
	High	Crack Sealing - AC
Depression	Medium	Patching - AC Deep
	High	Patching - AC Deep
Joint Reflective Cracking	Medium	Crack Sealing - AC
	High	Crack Sealing - AC
Longitudinal and Transverse Cracking	Medium	Crack Sealing - AC
	High	Crack Sealing - AC
Oil Spillage	N/A	Patching - AC Shallow
Patching	Medium	Patching - AC Deep
	High	Patching - AC Deep
Rutting	Medium	Patching - AC Deep
	High	Patching - AC Deep
Shoving	Medium	Patching - AC Shallow
	High	Patching - AC Shallow
Slippage Cracking	N/A	Patching - AC Shallow
Swelling	Medium	Patching - AC Deep
	High	Patching - AC Deep

Source: Applied Pavement Technology Inc, UDOA, 2006

Table A-4
Localized preventive maintenance policy for airfields,
portland cement concrete pavements (Micro PAVER airfield default table)

Distress Type	Severity Level	Maintenance Action
Blow-Up	Low	Patching - PCC Full Depth
	Medium	Patching - PCC Full Depth
	High	Patching - PCC Full Depth
Corner Break	Medium	Patching - PCC Full Depth
	High	Patching - PCC Full Depth
Linear Cracking	Medium	Crack Sealing - PCC
	High	Crack Sealing - PCC
Durability Cracking	Medium	Patching - PCC Full Depth
	High	Slab Replacement - PCC
Small Patch	Medium	Patching - PCC Partial Depth
	High	Patching - PCC Partial Depth
Large Patch	Medium	Patching - PCC Full Depth
	High	Patching - PCC Full Depth
Scaling	Medium	Slab Replacement - PCC
	High	Slab Replacement - PCC
Faulting	Medium	Grinding (Localized)
	High	Grinding (Localized)
Shattered Slab	Medium	Slab Replacement - PCC
	High	Slab Replacement - PCC
Joint Spall	Medium	Patching - PCC Partial Depth
	High	Patching - PCC Partial Depth
Corner Spall	Medium	Patching - PCC Partial Depth
	High	Patching - PCC Partial Depth

Source: Applied Pavement Technology Inc, UDOA, 2006

Table A-5
Localized safety maintenance policy for airfields,
asphalt-surfaced pavements (Micro PAVER airfield default table)

Distress Type	Severity Level	Maintenance Action
Alligator Cracking	High	Patching - AC Deep
Block Cracking	High	Crack Sealing - AC
Depression	High	Patching - AC Deep
Joint Reflective Cracking	High	Crack Sealing - AC
Longitudinal and Transverse Cracking	High	Crack Sealing - AC
Patching	High	Patching - AC Deep
Rutting	High	Patching - AC Deep
Shoving	High	Patching - AC Shallow
Slippage Cracking	N/A	Patching - AC Shallow
Swelling	High	Patching - AC Deep

Source: Applied Pavement Technology Inc, UDOA, 2006

Table A-6
Localized safety maintenance policy for airfields,
portland cement concrete pavements (Micro PAVER airfield default table)

Distress Type	Severity Level	Maintenance Action
Blow-Up	Medium	Patching - PCC Full Depth
	High	Patching - PCC Full Depth
Corner Break	High	Patching - PCC Full Depth
Linear Cracking	High	Crack Sealing - PCC
Durability Cracking	High	Slab Replacement - PCC
Small Patch	High	Patching - PCC Partial Depth
Large Patch	High	Patching - PCC Full Depth
Scaling	High	Slab Replacement - PCC
Faulting	High	Grinding (Localized)
Shattered Slab	High	Slab Replacement - PCC
Joint Spall	High	Patching - PCC Partial Depth
Corner Spall	High	Patching - PCC Partial Depth

Source: Applied Pavement Technology Inc, UDOA, 2006

Table A-7
UDOA's unit costs for preventive maintenance actions
(Micro PAVER default table)

Maintenance Action	Unit Cost
Patching - AC Leveling	$1.00/sf
Patching - AC Shallow	$2.00/sf
Patching - PCC Full Depth	$14.99/sf
Patching - PCC Partial Depth	$21.99/sf
Slab Replacement - PCC	$9.50/sf
Crack Sealing - PCC	$0.60/lf
Undersealing - PCC	$1.00/lf
Crack Sealing - AC	$0.60/lf
Grinding (Localized)	$20.00/lf
Joint Seal (Localized)	$1.00/lf
Shoulder leveling	$1.00/lf
Joint Seal - Silicon	$2.00/lf
Break and Seat	$0.30/sf
Patching - AC Deep	$5.50/sf

Source: Applied Pavement Technology Inc, UDOA, 2006

Table A-8
UDOA's unit costs for global maintenance actions
(UDOA's "AERO" table in Micro PAVER)

Maintenance Action	Unit Cost
Overlay - AC Thin (Global)	$0.90/sf
Surface Seal - Coal Tar	$0.11/sf
Surface Seal - Fog Seal	$0.09/sf
Surface Seal - Rejuvenating	$0.19/sf
Surface Treatment - Single Bitum.	$0.80/sf
Surface Treatment - Slurry Seal	$0.26/sf
Surface Treatment - Sand Tar	$0.18/sf
No Global M & R	$0.00/sf

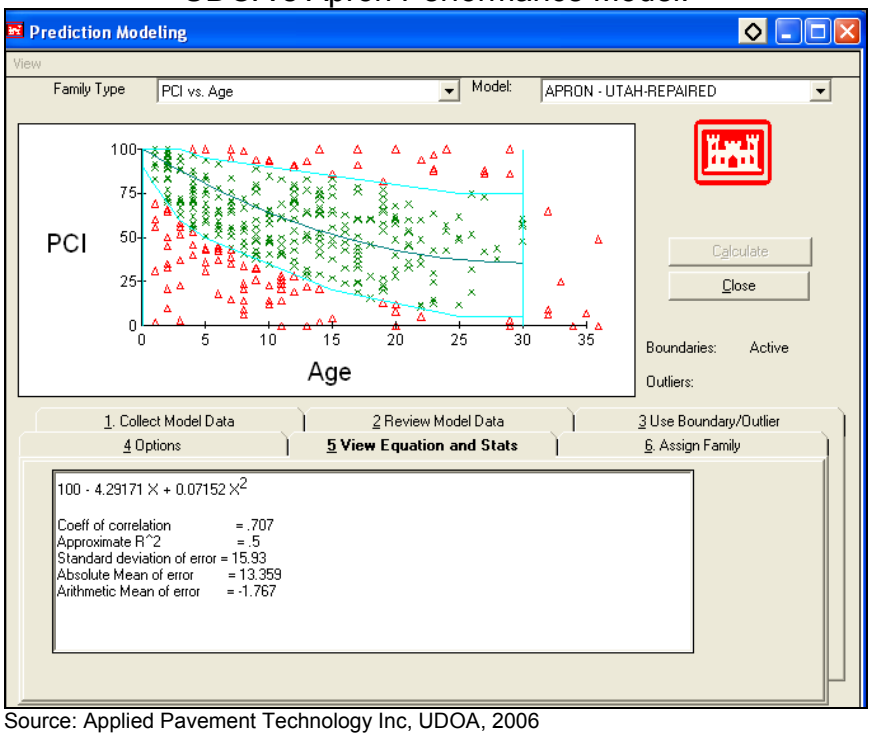
Source: Applied Pavement Technology Inc, UDOA, 2006

Table A-9. UDOA's costs for major rehabilitation based on PCI values
(Micro PAVER default airfield table)

	PCI Values										
	0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Unit Cost (per sf)	$3.33	$3.33	$3.33	$3.33	$2.88	$2.41	$1.94	$1.46	$1.00	$1.00	$1.00

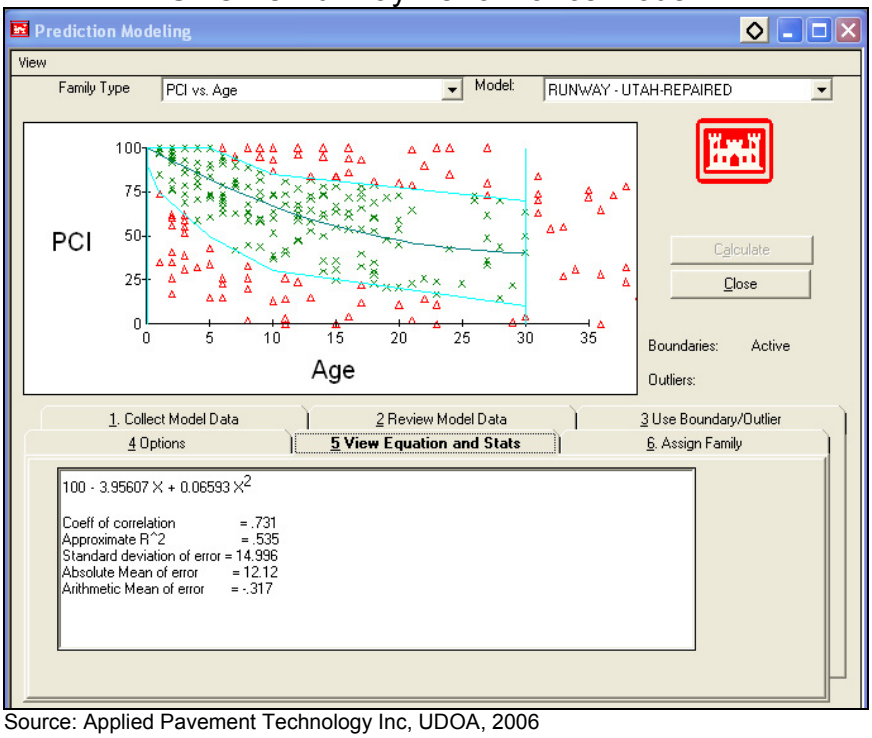
Source: Applied Pavement Technology Inc, UDOA, 2006

Exhibit A-5
UDOA's Apron Performance Model.



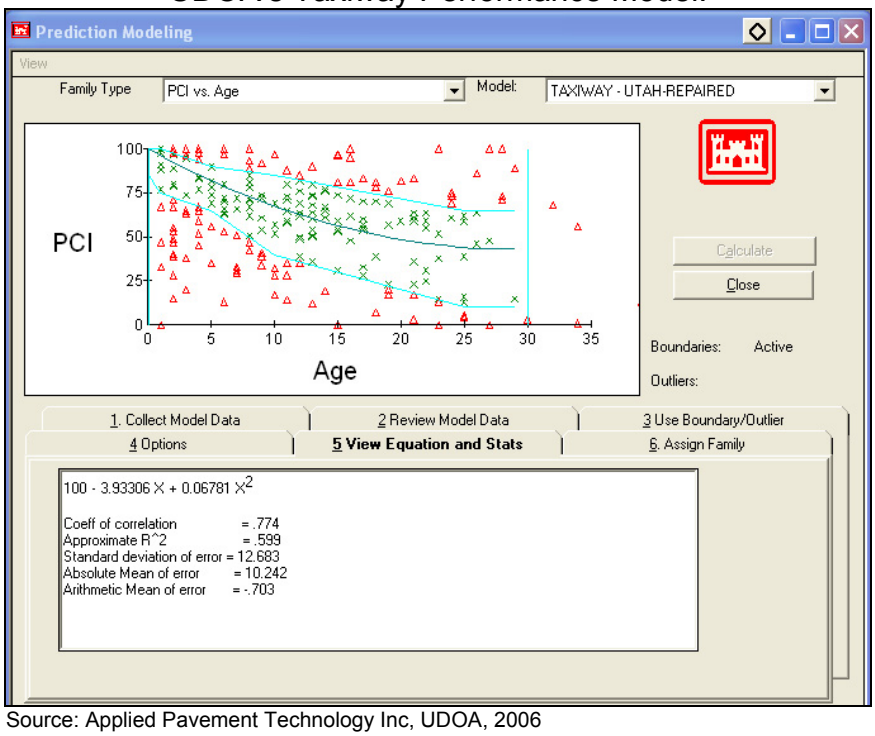
Source: Applied Pavement Technology Inc, UDOA, 2006

Exhibit A-6
UDOA's Runway Performance Model.



Source: Applied Pavement Technology Inc, UDOA, 2006

Exhibit A-7
UDOA's Taxiway Performance Model.



Source: Applied Pavement Technology Inc, UDOA, 2006